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FARMERS' BULLETIN 469.

Experiment Station Work, LXVI.

Compiled from the Publications of the Agricultural Experiment Stations.

LAWNS.
FERTILIZING ASPARAGUS.
TURNIPS FOR SHEEP.
LOSS OF LAMBS.
COST OF MARKET MILK.
PROPAGATION OF STARTERS.
THE PLASTERED SILO.

SEPTEMBER, 1911.

PREPARED IN THE OFFICE OF EXPERIMENT STATIONS.
A. C. TRUE, Director.

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EXPERIMENT STATION WORK.

Edited by W. H. BEAL and the Staff of Experiment Station Record.

Experiment Station Work is a subseries of brief popular bulletins compiled from the published reports of the agricultural experiment stations and kindred institutions in this and other countries. The chief object of these publications is to disseminate throughout the country information regarding experiments at the different experiment stations, and thus to acquaint farmers in a general way with the progress of agricultural investigation on its practical side. The results herein reported should for the most part be regarded as tentative and suggestive rather than conclusive. Further experiments may modify them, and experience alone can show how far they will be useful in actual practice. The work of the stations must not be depended upon to produce "rules for farming." How to apply the results of experiments to his own conditions will ever remain the problem of the individual farmer.—A. C. TRUE, Director, Office of Experiment Stations.

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ILLUSTRATIONS.

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EXPERIMENT STATION WORK.[1]

PERMANENT LAWNS IN THE SOUTH.[2]

Anyone familiar with the difficulty of securing good permanent lawns, particularly in the South, will appreciate the value of the results of experiments on this subject recently reported by C. C. Newman of the South Carolina station. In these experiments extending over nine years Prof. Newman tested 35 varieties of grasses and clovers to determine their suitability for lawn making. He says that "the first winter only a few of the varieties of grass were injured by the cold, but the following summer many of them died out completely on account of the drought. After the third year it was evident that our permanent lawns would have to be composed of one or more of the following grasses: Kentucky blue grass, Bermuda grass, herd's grass, and white clover."

The land on which the experiments were made had been under clean culture for several years, no grasses or weeds being allowed to mature seed.

The land was sown in peas in May, the vines being cut for hay in September. The pea stubble was then turned under with a two-horse hill-side plow, followed by a two-horse subsoil plow. The soil was harrowed repeatedly until a perfect seed bed was formed, and the seed sown the first week in October.

Six tons of manure that had been thoroughly composted and 300 pounds of lime were applied per acre before the land was plowed. After the land was plowed 600 pounds of fertilizer analyzing 8 per cent of phosphoric acid, 4 per cent nitrogen, and 5 per cent potash was applied per acre and thoroughly incorporated with the soil by harrowing. Each year, about the middle of March, nitrate of soda was applied to each plat at the rate of 75 pounds per acre.

It was found that a combination of Kentucky blue grass and Bermuda grass is especially well adapted to partially shaded lawns.

As Bermuda grass delights in the sun and the blue grass in the shade or where it is partially protected from the sun, these two grasses make a good combination for a permanent lawn in a grove or where there is an occasional

[1] A progress record of experimental inquiries published without assumption of responsibility by the department for the correctness of the facts and conclusions reported by the stations.

[2] Compiled from South Carolina Sta. Bul. 157.

large tree. The blue grass will predominate in the more shaded portions of the lawn and the Bermuda in the open, sunny places.

[To convert a Bermuda sod into a blue grass-Bermuda lawn] the Bermuda sod should be turned in September with a two-horse turning plow and harrowed thoroughly in order to pulverize all clods and make the land as smooth as possible. The manure and fertilizer should then be applied and worked into the soil with a harrow. About the 15th of October the blue grass should be sown and lightly rolled after raking or harrowing in the seed. The Bermuda will make no growth until the following spring, which will afford ample opportunity for the blue grass to become well established before the Bermuda starts to grow.

Kentucky blue grass thrives best on a clayey or clayey loam soil, yet when sown on sandy loam soil with good clay subsoil and with a northern exposure, it does well, provided the seed are sown in the early fall. If the seed are sown in the spring, the plants do not become well established before the hot, dry weather of summer and frequently by fall much of the grass is dead. If the seed are sown in the early fall, the grass will become well established before cold weather and will not be injured by the freezes of winter or to any great extent by drought in summer. The seed should be covered lightly by raking with a short-tooth smoothing rake and lightly rolled. If a large area is sown, the seed may be covered by means of a light spiked-tooth harrow, set with the teeth sloping at an angle of about 45°. Blue grass is a perennial, and spreads rapidly under favorable conditions by sending out many underground stems or root stocks which form a very compact sod. The seed should be sown at the rate of 35 to 40 pounds per acre.

Where neither blue grass nor white clover can be grown successfully, Bermuda is one of the very best grasses for a lawn. It will thrive on almost any kind of soil or exposure, yet it does best on land with a slight slope to the south or east. In the course of one year the Bermuda will form a compact sod. The roots should be planted either in the spring or fall. They may be scattered broadcast over the land before plowing or may be planted in rows about 2 feet apart, and by fall will have covered the ground. The lawn should be mowed several times during the summer or grazed in order to keep down weeds that would otherwise shade the Bermuda and check its growth to some extent. Bermuda is a perennial, and spreads rapidly from long, creeping, and branching stolons. It does not produce seed in the South and is therefore generally propagated by roots.

For large lawns around country homes or in large groves where a course grass is not obtainable, there is nothing better than orchard grass and red clover. The seed should be sown in October, using 8 pounds of red clover and 2 bushels of orchard grass per acre. Red clover and orchard grass will grow from 18 to 24 inches tall and will produce two crops of hay in a season. It should be cut a few days after the orchard grass is in full bloom. Orchard grass and red clover are both perennial.

Where a quick, temporary lawn is desired there is nothing better than Italian rye grass. * * * Italian rye is an annual when sown in the fall, but when sown in the spring will live over until the next year, when it will produce seed and then die. It may be used to advantage when sown in connection with Bermuda grass. For instance, if one desires to establish a sod of Bermuda, the roots may be planted in the fall and the ground then seeded to Italian rye grass. It will make a good sod six weeks after seeding and will not interfere with Bermuda, provided it is grazed or mowed several times during the season. After the second year the Italian rye grass will disappear, and the Bermuda will by this time have formed a good sod.

FERTILIZING ASPARAGUS.[1]

Methods of fertilizing asparagus have been discussed to some extent in a previous bulletin of this series,[2] in which it was stated that salt may be used with benefit in the small asparagus bed of the garden, that early spring applications of nitrate of soda are not likely to be of benefit in securing an increased cut of stalks the same season, and that, if the land is in good condition, a well-balanced commercial fertilizer may produce as good yields as manure and may be cheaper.[3]

On the basis of more recent experiments and observations C. P. Close and others, of the Maryland Experiment Station, make the following suggestions regarding soils and fertilizers for field culture of asparagus:

Almost any well-drained soil with plenty of humus in it will grow asparagus, but a good rich sandy loam is best. In preparing the ground for planting it should be deeply plowed and have large quantities of rotted manure worked into it. The asparagus grower must use whatever commercial fertilizer he has most faith in, because experimenters and growers do not agree as to what is best. Perhaps 1,000 to 2,000 pounds of kainit per acre in midseason is as good as anything, however, if a complete fertilizer is preferred the following is good: 400 pounds dissolved rock, 400 pounds kainit, and 200 pounds nitrate of soda in early spring.

The very best plants are strong 1-year-olds. About the only advantage in using older plants is to wait until they bloom so as to distinguish the males from the females and select the males which are the strongest and best producers.

After being thoroughly worked up the ground should be laid off in furrows 6 to 8 inches deep and from 4 to 6 feet apart. The best time for planting is early in the spring. The plants are set about 2 feet apart in the furrows and where they are placed the ground is often mounded slightly. The roots are spread out carefully and the earth is filled in 2 or 3 inches over the plants or "crowns" and as growth proceeds the ground is cultivated in until the furrows are finally filled. Thorough cultivation should be continued during the entire season and in late fall the tops should be cut off and removed from the field and be burned to destroy disease germs and insects.

The second year a good coating of stable manure, or 1,000 pounds of kainit per acre, or both, should be applied early in the spring and the entire surface should be plowed 4 inches deep. After thorough harrowing the shoots may be given time to grow a few inches, when cultivation should be begun and be repeated every 10 days or 2 weeks during the season. In late fall the stalks are again cut off and removed for burning. No cutting for market should be done the second year.

The third and succeeding years a light covering of rotted manure, about 5 tons per acre, should be given during the winter or early spring every year if possible, or every second year certainly. In connection with this manure some commercial fertilizer should be used, either a complete fertilizer as mentioned

[1] Compiled from Maryland Sta. Bul. 151.
[2] U. S. Dept. Agr., Farmers' Bul. 233, p. 11.
[3] For a complete account of asparagus culture see U. S. Dept. Agr., Farmers' Bul. 61.

below or kainit 1,000 to 2,000 pounds per acre. If manure is not available then a complete fertilizer must be used in early spring, at least 400 pounds dissolved rock, 400 pounds kainit, and 200 pounds nitrate of soda.

The ground should be plowed and harrowed again in early spring.

The kind of stalks desired for cutting, whether green or white, will determine how the ground will be handled at this time. If "green" stalks are wanted the ground may be left nearly level or at most only a slight ridge be made over the row.

If "white" stalks are desired, furrows from each side must be thrown over the row to form a round or flat topped ridge 8 or more inches high. There are special asparagus plows which do this ridging to perfection. The stalks must grow through the ridge and are blanched by doing so. The ground must be kept cultivated to keep down weeds.

As soon as the cultivating season is over in June, the entire ground is plowed about 4 inches deep and well harrowed. The shoots are then allowed to grow. Good cultivation must be given so that large amounts of plant food may be stored up in the roots and crowns to produce strong shoots the following year. After the tops die in the fall they should be removed and burned as before.

This treatment is given year after year as long as the plants are profitable.

The use of salt is not considered necessary. The above-described system of fertilizing, especially the use of kainit, furnishes a large amount of the same constituents supplied by salt and this probably renders the use of the latter unnecessary.

TURNIPS FOR SHEEP.[1]

T. R. Arkell, of the New Hampshire Experiment Station, finds that turnips in the winter ration materially reduce the cost of mutton production as compared with rations commonly used, and that under New Hampshire conditions they can be raised and stored at a cost low enough to compete with silage and in many cases may profitably supplant silage for sheep feeding. They thus offer a partial solution of the problem of securing a substitute for high-priced grains. He states that the chief danger in the use of turnips lies in heavily overfeeding or attempting to make them constitute the bulk of the ration, in which case they are liable to make the ration too laxative and produce scouring. On the other hand, owing to their watery nature, turnips render the ration more palatable and are distinctly useful when fed in moderate quantities in conjunction with hay and grain in preventing constipation and other resultant ills which so frequently occur when sheep are changed from pasture to dry feed.

In the experiments upon which these conclusions are based turnips were fed at the rate of 5 pounds per animal in connection with ¾ to 1 pound of mixed grains (oats, bran, and corn in equal parts by weight) and 1¼ to 2 pounds of clover hay, the daily cost of the ration being 3½ cents per animal.

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[1] Compiled from New Hampshire Sta. Bul. 152.

LOSS OF WINTER-FED LAMBS.[1]

A trouble resembling apoplexy in human beings has for several years been causing large losses among winter-fed lambs near Batavia, N. Y., a region where feeding lambs for the winter market is a large industry.

The lambs are bought largely in Buffalo or Chicago, fed for a period of three and one-half to four months on a highly fattening ration, and when fat are shipped back to Buffalo to be slaughtered. Two crops of lambs are fed each year. The first lot is bought about November 1 and is marketed in February. They weigh about 60 pounds at purchase. It is considered that the greatest profit is realized when they are marketed in 90 to 120 days at a weight of 80 to 85 pounds. If the feeders are able to dispose of their first crop early in February, they usually get another lot to be finished as early as possible up to June 1. The feeders utilize the hay from their farms, alfalfa, clover, or timothy, together with bean fodder, if they have it, and mill feeds, with a relatively large part of the rations made up of corn and linseed-oil meal. Usually the corn is fed whole and the oil meal preferably in the form of the oil cake broken up into pieces a little larger than peas. * * *

The trouble appears suddenly and does its work quickly. It is sometimes accompanied by paralysis. It nearly always proves fatal, only about 1 or 2 per cent of those afflicted ever having been known to recover. The disease seems to occur only where lambs are being fed heavily, and it then attacks the strongest and most vigorous. * * *

While this disease has been prevalent for some years, its exact cause has not yet been determined. Two opinions have been set forward: First, that the disease is caused by feeding an excess of protein in the ration; second, that the disease is caused by overfeeding.

Investigations by the department of animal husbandry of Cornell University Experiment Station indicated that the trouble is caused mainly by sudden overfeeding rather than from feeding a narrow (high-protein) ration. The best results were obtained on rations with a relatively narrow nutritive ratio—that is, 1 : 5. It seemed to be clearly shown that in a fattening ration for lambs a relatively large amount of protein is necessary to keep the lambs up on the heavy grain ration required for the best results in fattening.

In the opinion of those who conducted the experiments on the subject there should not be the wholesale loss from overfeeding that some feeders have experienced if proper precautions are taken to keep the rack spaces all occupied and to distribute the grain equally, although there may be an occasional loss from the heavy feeding or loss from nervous excitement, which is thought to be one cause of apoplexy.

The ration giving best results was alfalfa hay in the morning, bean fodder at night, with a grain mixture for 25 lambs of 30 pounds corn, 30 pounds wheat salvage, and 15 pounds oil meal. From November 4,

[1] Compiled from New York Cornell Sta. Buls. 285 and 305.

when the lambs were bought, until November 15 they were fed only hay. At this date they were started on a mixture of equal parts by measure of corn, oats, and wheat bran.

On December 1 all three pens were consuming one-half pound of grain in two feeds and about 1¾ pounds of fodder per day per head. Care was taken to have the grain evenly distributed through the racks. As the amount of grain was increased the fodder was diminished, until it reached 65 pounds for 50 lambs per day, or 1.3 pounds per head, after which the amount of fodder was not changed throughout the remainder of the experiment. The lambs were purposely very closely confined as to rack space from the first. * * *

On December 25 the lambs were eating 1 pound of grain per head per day. The increase in grain was made very slowly and carefully, so as not to cause any trouble in digestion. On January 15 they were eating 1½ pounds of grain per lamb per day.

In later experiments it was shown "that succulence in the ration is very desirable and silage or roots should be fed if obtainable. * * * The most economical ration was that with a nutritive ratio of 1:5.3, with silage for succulence. This ration produced the largest gains at the lowest cost per pound of gain."

It therefore appears from these investigations that large losses in winter feeding may be avoided by gradually increasing the ration fed, which should contain some succulent material, and exercising great care to see that it is evenly distributed among the lambs, none getting more than its proper share. The latter is done in large measure by restricting the rack space to that actually necessary and evenly distributing the feed in the racks.

COST OF MARKET MILK.[1]

The increased price of labor and of feeding stuffs during the past decade has caused the dairyman to consider more carefully the actual cost of milk production in order to discover wherein his expenses may be reduced, as the advance in the price of milk has not kept pace with the increasing cost of production. One of the first steps to be taken in reducing the cost of producing milk is to dispose of the poorest cows in the herd, and these can be detected by keeping individual records of each cow. The importance of these records has been emphasized in previous issues of this series.[2] Another important step is to determine the actual cost of milk production after the poor milkers have been eliminated. This cost necessarily varies

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[1] Compiled from Rpt. Sec. Agr. 1910, p. 20; Illinois Sta. Circ. 134; ~~Massachusetts Sta. Rpt. 1910, pt. 2, p. 27~~; New Jersey Stas. Rpt. 1909, pp. 56–76; New York State Sta. Bul. 322; Canada Expt. Farms Rpts. 1910, p. 67; Report of the Commission on the Cost of Living. Boston: Govt., 1910, p. 216; Report of the Attorney General in the Matter of the Milk Investigation. Albany: Govt., 1910; U. S. Dept. Agr., Bur. Anim. Indus. Circ. 170.

[2] U. S. Dept. Agr., Farmers' Bul. 366, p. 20.

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with the price of feeding stuffs, methods of management, and so many other factors that to determine the cost of producing milk with any degree of accuracy is not an easy matter. Many estimates have been published which are valueless because of the faulty methods of keeping farm accounts.

G. M. Whitaker, of the Dairy Division of this department, has discussed[1] the wide variation in statements of those milk producers who claim to keep systematic accounts, and pointed out that until producers improve their methods of bookkeeping the exact cost of producing milk will remain a debatable question.

In order to simplify methods of determining the value of individual cows, W. J. Fraser, of the Illinois Station, has prepared a table which is based on the findings of the department of dairy husbandry at that station for the past 15 years. By means of this table, and knowing the annual milk yield, the profit or loss of any cow can be easily estimated.

Economic conditions are not the same in different parts of the country, and while this table is made to apply especially to the Central West, it should be found applicable to the entire country. In the eastern part of the United States feed is higher, and it will cost more to keep a cow a year than in the Central West, but the value of the product is also greater, while in the West the cost of keep will be less than in Illinois, but the receipts for the product will also be less. For these reasons the application of the table should be a good guide in any part of the country, and its object accomplished, as it is designed to show, in the most striking manner possible, the difference between good and poor herds for the purpose of making money.

The price for the product is considered at the market value of butter fat at the creamery, and this price should be obtained by any dairyman in the State, no matter what his location. If the milk were shipped to a city for direct consumption, retailed directly to the consumer, or cream sold for a fancy trade, the returns would be much greater than indicated in the table.

The production per cow is the average for six years—the length of time cows are milked in most herds. Although some cows produce for twice this length of time, there are also many which drop out after only one or two years' production.

The value of the cows producing the different yields is estimated as nearly as possible at their actual market price. Cows producing 2,000 pounds of milk are valued at $30, and their value increases $5 for every additional thousand pounds produced up to 6,000 pounds; above this, $10 for every thousand pounds' increase in production.

The value of cows when disposed of is estimated at $30 for cows producing 2,000 pounds of milk, and this price decreases to $25 for cows giving 5,000 pounds of milk and above.

The amount of skim milk is figured as 85 per cent of the whole milk, as this is the amount returned from creameries or obtained from the hand separator on the farm.

Skim milk is valued at 20 cents per hundred pounds, since the best data show that it requires an average of 5 pounds of skim milk to equal 1 pound of

[1] Hoard's Dairyman, 41 (1010), No. 50, p. 1478.

grain in pork production. When grain is worth 1 cent a pound, or $1 per hundred pounds, skim milk would be worth 20 cents per hundred pounds. If the skim milk is fed to heifer calves of good quality, the value will vary from 20 cents to $1 per hundred pounds, depending upon the conditions and the quality of the calves.

Calves from cows producing less than 5,000 pounds of milk annually are considered at veal prices only, and are valued at $3 when 5 days old, when the milk of the dam is fit for use. From cows producing more than 5,000 pounds of milk annually the value of the heifer calves increases more rapidly, as the dams are more efficient producers. Bull calves are not considered of value except for veal, unless they are from cows producing an average of 10,000 pounds of milk annually, in which case their value is placed at $16, and this value increases at the same rate as the heifers from higher producing dams. The question may rightly be raised if bulls from grade cows should be used for service. It would be better not to do so, unless it is known that the dams were, for at least two generations, good producers, but at the present stage of dairy cattle breeding in the United States, bull calves from cows producing an average of 10,000 pounds of milk for six years would be of service in increasing the production of our future dairy cows. In fact, it is by this method that the dairy cattle of Denmark have been so markedly improved in the last 25 years.

The manure is figured at 11 tons per head for cows producing 8,000 pounds of milk. On the 20-acre dairy farm at the university last year cows which were kept in the barn during the winter and in a dry lot during the summer produced 13 tons of manure per cow. The average value is considered at $1.50 per ton. At the Illinois Agricultural Experiment Station, on a three-year rotation of corn, oats, and clover, manure has increased the crop yield $1.60 for each ton of manure used, figuring the market value of the crops, for the first three years after it is applied. No consideration is taken of the increased production from the effects of the manure after the first three years. At the Ohio Experiment Station the value of the crop yields has been increased $2.34 for each ton of manure used. From the figures above stated, $1.50 a ton is a conservative value on cow manure which has been well cared for. Cows which produce less than 8,000 pounds of milk will produce, on the average, less than 11 tons of manure. Cows producing more than 8,000 pounds of milk will not only produce more manure, but it will be of a better quality, owing to the fact that they are fed more concentrates. For these reasons the value of the manure is lowered 50 cents per cow for every 1,000 pounds' decrease in production of milk below 8,000 pounds, and raised 50 cents per 1,000 pounds' increase in production above 8,000 pounds.

The labor per cow at the dairy of the University of Illinois has amounted to $22, where the cows were stabled continuously throughout the year. This is more, decidedly, than it will cost under the ordinary farmer's conditions; hence $20 is taken as a basis for labor on cows producing 8,000 pounds of milk annually. The labor for cows producing less than 8,000 pounds of milk will not depreciate materially, as feeding, watering, cleaning stables, and caring for the individual cows will be practically the same, regardless of their production, and cows giving less milk will be much slower milkers, thus requiring more time per pound of milk obtained. The labor is reduced only 50 cents for every thousand pounds decrease in milk production below 8,000 pounds, making a minimum cost on a cow producing 2,000 pounds of milk, $17. With increased production, only a small amount of extra labor is required in caring for the cows, and as large producers give down their milk more freely, less

time is consumed per pound of milk in milking, and $1 is added to the cost of labor for each 1,000 pounds increase in yield.[1]

The average barn for a herd of 40 cows is worth $2,000, or $50 per cow. The interest on this, per cow, would amount to $2.50 a year, and taxes, insurance, repairs, and depreciation will amount to $1.50 a year, making a total cost per cow for buildings and their maintenance, of $4 per year.

The total annual expense of keeping a good pure-bred sire, including feed, care, and depreciation, is $75. In a herd of 40 cows, $2 per cow must be allowed annually to have each calf sired by a pure bred. Since this amount is so small, every dairyman should keep a good pure-bred sire, even though he has but a small number of good cows in his herd.

On the average, cows will be kept in dairy herds for six years, therefore the annual depreciation on the cow is figured as one-sixth of the difference between the value at the time of first freshening and the value when disposed of. To this must be added the interest on the value of the cow each year.

Spraying materials, medicine, and veterinary service are estimated at 10 cents per 1,000 pounds of milk produced. While the relative increase is rapid, it is true that the large producers are the ones requiring more medical attention, and cows producing only 2,000 or 3,000 pounds of milk in a year need little, if any, of this expenditure.

The expense for dairy utensils, if the milk is taken to a condensing factory, bottling plant, or creamery, should be about 90 cents for a cow producing 8,000 pounds of milk. If the milk is separated on the farm, fewer cans are required and less expense is involved in hauling the milk, but, to offset this, there is an additional outlay for a cream separator. If milk is shipped to a large city it is necessary to have five sets of cans, which, being badly handled and frequently lost, makes the expense for cans heavy. However, as the milk is sold by measure, it has been found by actual practice that the denting of the cans soon makes them hold enough less milk to compensate for the wear, tear, and loss on cans. Since the cost of utensils will depend somewhat upon the amount of milk handled, an allowance of 5 cents per 1,000 pounds of milk produced is made. * * * It can be seen that in the case of the cows producing less than 9,000 pounds of milk, the skim milk, calf, and manure do not pay for the labor, housing, service fee, and depreciation on cows and utensils, while with cows producing more than this amount, these returns are so much greater that there is a rapid rise in profit as the production increases.

To obtain the final results of profit or loss per cow, the milk, to be as near the average for all breeds as possible, is considered to contain 4 per cent butter fat, which is the average of the 1,200 cows tested by this station. In applying the table to a herd, computations for each individual cow must be made, depending upon the total amount of butter fat in her milk.

The value of the butter fat is based upon the Elgin prices for butter during the years 1907 and 1908, which averaged slightly above 27 cents. The overrun, which is the amount of butter made above the amount of butter fat, is allowed for the expense of making the butter.

The cost of feed per cow is based on the prices of feed for the past two years, which is decidedly higher than formerly. The cost of feed is raised $2 for each 1,000 pounds increase in production of milk. This increase is based upon a large number of yearly records kept at the University of Illinois, where an ac-

[1] No account is here taken of the cost of superintendence, but only of unskilled labor at ordinary prices.

curate account is kept of all feed consumed and milk and butter fat produced for the entire year, on cows that vary in production from 2,000 to 15,000 pounds of milk annually. Too much emphasis can not be placed upon the fact that the milk is made more economically by the higher producers, as they are far more efficient cows.

The table may safely be used as an index to the profits, because under existing conditions nearly all herds contain individual cows of vastly different production. On the majority of dairy farms in the intensive dairy region of Illinois, all cows in milk are fed practically alike as to grain, regardless of their production, and their being in the same herd, the cost of all items for the different cows will be nearly the same. Under these conditions the actual difference in profit between the good and poor cows will be even greater than the table indicates.

These figures are based upon definite data worked out at the experiment station, but the result will fluctuate slightly, according to the way the herds are fed. The price of feed varies in different years, but as a rule the price of the product varies with the feed, so that this fluctuation is small. When a dairyman uses this table, the question is not whether the results obtained are absolutely correct to a few cents, as it makes no special difference to a farmer whether a cow brought in a profit of $10 or $10.50, but it does make an enormous difference whether she lost him $5, or made him $20, as may be easily done by ordinary cows producing within the range of many cows in the average herd.

Until a more uniform system of keeping dairy accounts is adopted the cost of production as determined by different individuals is hardly comparable, but in the absence of the ideal scheme it is thought desirable to cite a few estimates that have been made by several stations and by private individuals on the cost of production, as they point out the necessity for more accurate figures in this connection. In addition a few figures are given on the cost of bottling, railway transportation, and delivery by the retailer.

At the New Jersey Station the average cost of feed per quart of milk was 3.04 cents, and the total cost of milk, including labor, was 4.16 cents per quart, when the figures were based on the cost of growing the feed consumed. When the cost per quart was based on the market price of feed, the total cost was 4.8 cents per quart.

At the New York Geneva Station the cost of milk per pound[1] was found to range with different cows in 1906 from 0.48 to 1.34 cents; in 1907, from 0.6 to 1.578 cents, and in 1908, from 0.655 to 1.838 cents.

At the Canadian Experimental Farms, in a herd of 49 cows the cost ranged from 52.2 cents to $1.67 per 100 pounds. At the Massachusetts Station the average yield per cow in 1907 was 5,874.4 pounds of milk. The food cost per cow was $78.19, and the food cost of a quart of milk was between 3 and 3.2 cents. In 1908 the yield per cow was 5,639.5 pounds of milk and the food cost $82.21 per cow, making

[1] A quart of milk weighs 2.15 pounds.

the food cost per quart of milk 3.3 cents. If other items of cost had been added to the food cost, it is estimated that the total cost of producing milk satisfactory in sanitary quality and containing from 4 to 5 per cent of butter fat would have amounted to 4 or 5 cents per quart. It is stated that milk produced under more than average sanitary conditions would naturally cost considerably more than the figures presented in these estimates.

Mr. Whitaker estimates that in determining the extra cost of producing clean milk in a 15-cow dairy there will be an added expense of 5 cents per cow per day for labor plus 5.5 cents for new or additional equipment in extreme cases. To this should be added 5 cents more to remunerate the proprietor for his extra care and vigilance, making an extreme increase of 15.5 cents per cow per day. As the product of a cow ranges from 4,000 to 10,000 pounds of milk per year, or from 5 to 12 quarts a day, the added expense for labor would amount to from one-half to 1 cent a quart; and in rare instances, where great additional expense is required for repairs, new construction and new equipment, these might raise the increase 1 or even 2 cents a quart more. It is thought, however, that this added expense of improved methods and equipment would be partly offset by increased production and increased economy of feed, so that the net extra expense of producing clean milk would probably be somewhat less than the figures given. Reasonably clean milk is worth 2 cents more than common, slovenly milk. The former is safer and, therefore, cheaper at the increased price, whereas dirty milk ought not to be considered a merchantable article at any price, no matter how low. Prof. Heinemann estimates that a sanitary milk containing not more than 1,000 to 2,000 bacteria per cubic centimeter even when delivered for consumption 100 miles away can be produced, bottled, and sold at a profit for 6 cents per quart in a plant where the output is 250 quarts per day.

Prof. Sanborn[1] states that on his farm in New Hampshire it cost $121.67 to produce 6,000 pounds of milk. Mr. E. D. Howe, a Massachusetts farmer,[2] states that it cost over 6 cents per quart to produce the milk and 2.7 cents per quart for delivery. These figures are given for ordinary milk. Mr. B. W. Potter[3] states that the cost of producing a quart of ordinary milk is 5 cents, and certified milk 10 cents per quart. Mr. J. B. Greer[4] estimates that the cost of producing milk on a 160-acre farm near Elgin, Ill., was

[1] New England Farmer, 89 (1910), No. 48, p. 5.
[2] Rural New Yorker, 69 (1910), No. 4078, p. 1187.
[3] Country Gent., 75 (1910), No. 2985, p. 379.
[4] Prairie Farmer, 84 (1910), No. 20, p. 8.

about 2.43 cents per pound. The average cost of producing milk in 1908 and 1909, as testified to by producers at the investigation of the New York State attorney, was 3.513 cents per quart. A New York dealer in milk testified that the freight, bottling, carting, and delivery amounted to 5 cents per quart. W. A. Graustein, of the Boston Dairy Co., submitted figures to the Massachusetts Cost of Living Commission showing that the cost of handling and delivering a quart of milk at retail from the time it enters the bottling room in Boston until it reaches the consumer is 3.2 cents. This would make the cost of a quart of milk 8.3 cents, distributed as follows: Paid to the farmer 4.41 cents, cost of transportation 0.69 cent, delivery to the consumer 3.2 cents. These figures include nothing for profit, interest, supervision, or losses. Other dealers stated that this total is too low and that milk can not be delivered for less than 3.7 cents per quart.

The Secretary of Agriculture reports as follows concerning the investigation of prices of transporting and delivering city milk supply:

While it is true that the dairyman is receiving considerably more for his milk than he did before the present era of high prices, yet it was discovered in this investigation that throughout the United States he receives a scant 50 per cent, or one half, of the price paid by the consumer. The other half goes to the railway company for carriage, to the wholesale milk dealer, if there is one in the chain of distribution, and to the retailer who delivers at the consumer's door.

Freight charges for carrying milk vary according to distance, but their average may be regarded as approximately about 7 per cent of the consumer's price. With the farmer receiving about 50 per cent of that price and the railroads 7 per cent, the remaining 43 per cent of the consumer's price is received mostly by the retailer.

The milk wagon of the retailer has a long route. It stops at a house or two in one city block, perhaps passes several blocks without stopping, and so proceeds to serve customers thinly distributed along a route of miles. At the same time the milk wagons of other retailers are covering various portions of the same route, and so there is great waste of effort and of expense in the distribution.

The division of States in which the cost of distributing milk from producer to consumer is the most in the North Central group, in which producers receive 44 per cent of the prices paid by the consumer. Next in order follow the Western States with 47 per cent, the North Atlantic States with 53 per cent, the South Central States with 55 per cent, and the South Atlantic States with 57 per cent.

The average price paid by consumers in the 78 cities is almost exactly 8 cents per quart. In the North Atlantic and North Central States the average is 7.5 cents; in the Western States, 8.9 cents; in the South Central, 9.1 cents; and in the South Atlantic States, 9.3 cents. These prices are for the last week in June, 1910.

PROPAGATION OF STARTERS FOR BUTTER MAKING AND CHEESE MAKING.[1]

E. S. Guthrie, of the New York Cornell Station, gives the following brief directions for propagating a starter "containing desirable bacteria for the ripening or souring of dairy products":

1. Take three 1-quart milk bottles or fruit jars.[2] Glass is preferable, as it allows the operator to see when all of the dirt has been removed, and the condition of the curd can easily be inspected through the transparent wall. Three bottles should be employed, for in heating glass is likely to break; and it is always well to have a sufficient number of containers from which to choose.

2. Use fresh, clean milk, which must have a nice flavor. It may be either whole milk or skimmed milk. Usually it is advisable to use whole milk, for it is easier to choose desirable samples before milk has passed through the separator than afterwards.

3. Fill the containers one-half to two-thirds full of milk. If they are filled full, it is difficult to prevent contamination from the covers, which are hard to sterilize when the pasteurization is done in hot water.

4. Protect the containers with regular covers (caps or tops). Hastings, of Wisconsin, recommends the use of glass tumblers for covers.

5. Pasteurize by heating to 180° to 200° F. for 30 minutes[3] or longer and then cool to ripening temperature of 60° to 75° F. Pasteurization may be accomplished by tying a string about the necks of the bottles and suspending them in a pail or vat heated by steam or in a kettle or dish heated on a stove. (If pasteurized over a fire, do not let bottles rest on the bottom of receptacle.) Other supports may be used to keep the containers from tipping over. The temperature should be raised and reduced slowly to prevent breaking the glass.

6. After pasteurization the milk is ready for inoculation. Inoculate in a quiet place where the wind can not blow dirt and bacteria into this clean seed bed. With dry fingers remove the cover and place it in a bacterially clean spot, as in a recently scalded dipper. Pour in all of the commercial culture or 2 to 10 per cent from the previous day's culture.[4] Be sure that the curd from the previous day is well broken. After inoculation, shake the freshly inoculated sample to distribute the bacteria.

7. Incubate at about 60° to 75° F. The first inoculation from the commercial culture should be incubated at about 70° to 85° F. The small inoculations require higher temperatures than the large inoculations. By experience an operator can soon learn what inoculation and temperature to use to ripen his starter

[1] Compiled from New York Cornell Sta. Circ. 10.

[2] Larger receptacles may be used. Often 2-quart bottles or jars are used.

[3] Rouska, formerly of Iowa, says: "A temperature of 150° F. kills all sporeless bacteria. Higher temperatures up to 212° F. do not kill the spores, but they are so weakened by the higher heat that they germinate more slowly and their harmful effect is retarded. This fact and the results of experience indicate a temperature of about 185° F. to 200° F. as best. The heating and cooling can be done in cans immersed in water. Stirring hastens the processes, but is not necessary when the heating surface is not hotter than about 200° F. Where the heating is done by steam, stirring is necessary to prevent scorching."

[4] The amount of ripened starter for inoculation can be measured accurately in a vessel, as a sterilized cup or spoon, or it can be determined rather closely by the eye. Place the thumb above the milk line in the bottle to be inoculated, in this way measuring the amount to add, and raise the milk line to that mark by pouring in the ripened starter.

in a given time. Usually a 6 per cent to 8 per cent inoculation will ripen a starter in 12 hours at about 65° F. The temperature must be fairly constant.[1]

8. The starter is ripe when a curd forms. This curd should be soft and like custard in appearance. It should not be hard and firm.

9. After the starter is ripe, hold it at 50° F. or a few degrees lower until time to use. For best results a starter should not be held longer than a few hours. However, it may be held two or three days and not be badly overripened. Do not shake the starter before putting it in storage.

10. Upon examination the curd should be smooth and compact, without gas pockets. Gas shows the presence of undesirable bacteria. A hard, lumpy curd, whey, and high acid show the overripe condition, which is very undesirable. After the condition of the curd is noted, shake well to break it into a smooth, lumpless condition. Shake with a rotary motion, being careful not to touch the cap for fear of contamination. Now smell and taste it, but never from the starter container. Always pour some of the curd into a spoon or cup, and then replace the cover immediately. After smelling, it is best to put at least a teaspoonful into the mouth. Seek for a desirable, clean, mild, acid flavor. The first propagation is likely to be somewhat disagreeable, because of the presence of some of the original medium.

In a creamery or a large dairy it is necessary to carry more than a pint or a quart of starter. Along with the mother starter a second starter of 10 to 50 pounds may be carried. After the mother starter in the glass container is inoculated, the remainder of the previous day's mother starter is poured into the second starter, and the cream is inoculated from the second starter. In large creameries third and fourth starters are carried. Care should be taken in pasteurization not to cook the milk in these large amounts. In the mother starter this makes little difference.

It is necessary to use a larger inoculation from starter to cream than from starter to starter, because the seed bed is not so well prepared. The inoculation of the cream may vary from 8 per cent to 50 per cent.

Usually it is necessary to propagate the mother starter two or three times before the flavor of the commercial culture, which is often very disagreeable, will disappear.

A starter may be carried two to four weeks before it goes "off." Often it is carried several months, and often less than two weeks. This depends almost altogether on the carefulness of the operator.

On the farm the cream might be handled in this way: Suppose the dairyman separates each half day 10 pounds of cream testing about 35 per cent butter fat. On Monday a new starter of about two-thirds of a quart is inoculated from a starter that has been held from Friday or Saturday. The remainder of the held-over starter is put in the 10 pounds of cream. The cream is then set at about 65° F. It may have to be set in a cooler place before evening. In the evening 10 pounds more cream are added and all the cream, which is now in the one vessel, is set at about 60° F. On Tuesday morning add the morning's cream and set at 60° to 65° F., as during the day it is more convenient to watch the ripening process than at night. In the evening add the evening's cream and set at 58° to 60° F., for by this time there is a very large army of bacteria at work. On Wednesday morning churn the 40 pounds of cream and start the ripening process over again with Wednesday's cream.

It is important not to develop too much acid. The amount of inoculation and the temperature must be managed to gain a certain end under certain conditions.

[1] An incubator should be insulated as is a refrigerator or a fireless cooker.

THE PLASTERED SILO.[1]

H. E. McNatt, of the Missouri station, states that one of the most successful types of silos is that generally known as the "plastered" or Gurler silo. This type is especially adapted to regions where lumber is comparatively cheap. The advantages of this silo are that (1) it can be built entirely from ordinary lumber; (2) it requires no highly skilled labor for its construction; (3) it preserves the silage as well as any type of silo in use; and (4) it is strong and durable when properly made.

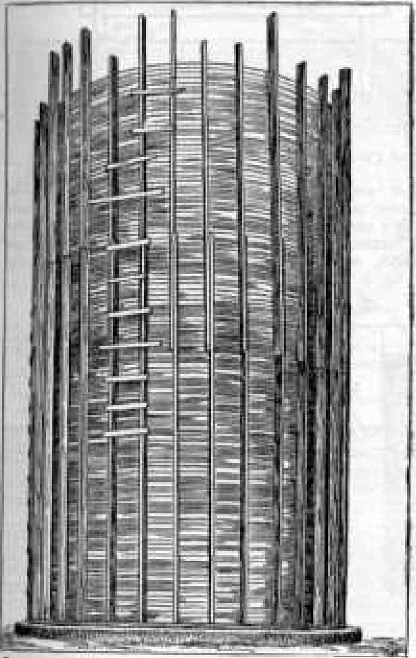

FIG. 1.—A plastered silo complete, except siding and roof.

It is built much like a frame house, except that it is round in form, with a lining of boards running lengthwise around it, somewhat like the hoops of a barrel, which give it strength to resist the immense pressure of the silage. (Fig. 1.) Its cement plastered wall protects the wood framework from decay.

It is not advisable to have the silo more than 16 feet in diameter. "The best proportions are height about twice the inside diameter." The silo is constructed as follows:

A short stake is driven firmly into the ground at the point selected for the center of the silo. To the top of this is secured, with a single nail, a horizontal piece of light, stiff lumber, bearing upon one end an arm sharpened so as to scratch a circle on the ground when moved around the center post. (Fig. 2.)

[1] Compiled from Missouri Sta. Circ. 48.

This circle marks the outside limit of the silo foundation and care should be taken to get the measurements correct.

With the circle as a guide a pit is dug to a depth of from 2 to 3 feet. The wall of dirt is cut plumb and the floor leveled.

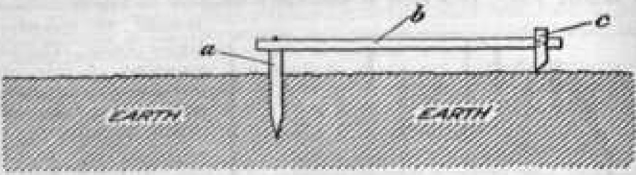

FIG. 2.—Arrangement for marking out circle for foundation.

The foundation is reenforced concrete. Figure 3 shows in cross section the construction of one of the frames, which hold the form boards in place. These frames, which are made of 1 by 4 plank, should be placed 30 inches apart around the pit to hold the inside and outside form boards in place. These boards are half-inch lumber of 4-inch width, so as to be readily bent to conform to the

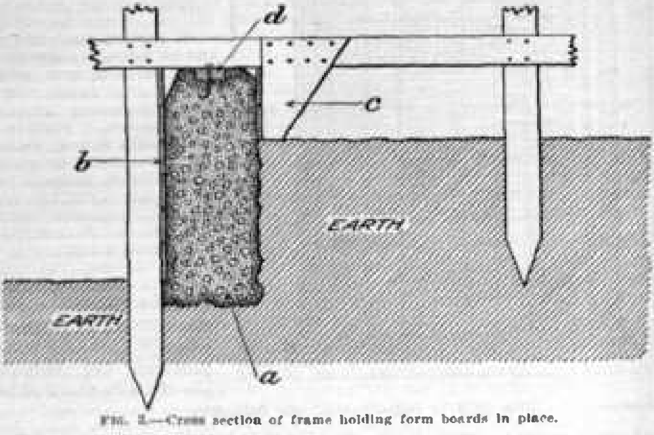

FIG. 3.—Cross section of frame holding form boards in place.

wall of the pit. The distance between the inside form boards and the pit wall should be 1 foot. The concrete foundation should extend about 1 foot above ground on the outside. Figure 3 also shows how the upper corners of the concrete wall are beveled after the concrete has become sufficiently stiff to permit of this being done. The 2 by 4 sill with a large spike for an anchor is also

shown embedded in the top of the wall. The concrete should be made from clean, sharp sand and enough Portland cement to insure a strong mixture. The proportions will run about as follows: 1 part cement, 2½ parts sand, and 5 parts of broken stone. Enough water is added during the mixing, which must be thoroughly done, to make a mixture that is thin enough to settle to the form with light tamping, but not so thin as to carry the cement out through the cracks of the form by the water leaking out. The foundation is reenforced with a piece of 3-foot woven wire fencing placed in the center of the form before filling with the concrete mixture.

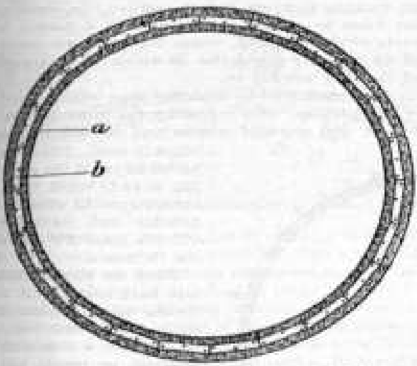

FIG. 4.—View of foundation from above, showing sill.

After the wall has set sufficiently to stand alone, the forms may be removed and the floor laid to a depth of 4 inches. It is advisable but not absolutely necessary to pack about 4 inches of wet cinders in the bottom of the pit before laying the floor. Before the wall and floor have hardened, a finishing coat of sand and cement mixed 3 to 1 should be put on with a plasterer's trowel.

Figure 4 shows a view of the top of the foundation wall with the sill in place. The sill is made of 2 by 4 lumber cut into 2-foot lengths. Each piece is put in place while the concrete is soft and anchored by 3 heavy spike nails with turned points, or thin bolts with nuts and washers on their ends. This anchoring is necessary, and ties the woodwork of the silo firmly to the concrete.

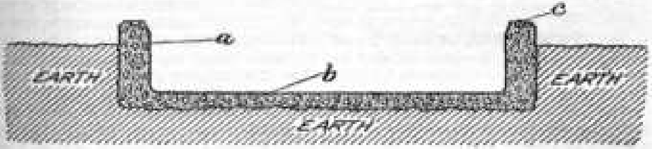

FIG. 5.—Vertical section of foundation wall, showing sill.

Figure 5 shows a vertical section of the foundation wall and floor as it appears when complete.

The studs are made of 2 lengths of 2 by 4 lumber spiked together at the middle and are erected 2 feet apart. If the diameter and height of the silo are more than about 16 feet by 32 feet, it is advisable to either use 2 by 6 lumber or set the studding only 18 inches apart. Two pieces of 2 by 4 lumber spiked to-

gether to make a 4 by 4 is used as a center pole to tie the studding to while they are being set up. Each separate stud is toenailed to the center of a section of the sill. Only the lower half of the studding is put up first, the second piece being spiked on after the lower half of the silo is nearly complete and needs no bracing. The studding is plumbed with a carpenter's level and tied in position temporarily with small scraps of old lumber.

When the lower half of the studding has been tied in position, the sheeting, which is one-half inch lumber made by ripping 1 by 4 or 1 by 6 lumber, is nailed horizontally on the inside of the studding, taking care to break joints. The sheeting should be nailed on from the foundation to within about a yard of the top of the studding and then the lath put on.

Although somewhat expensive, the sheet steel or expanded steel lathing found on the market is the best for the purpose. But ordinarily the same material as the sheeting ripped into inch and one-half widths and beveled on the edges is used. These are nailed on top of the sheeting, so as to break joints, covering cracks whenever possible and leaving a suitable space for clinching the mortar.

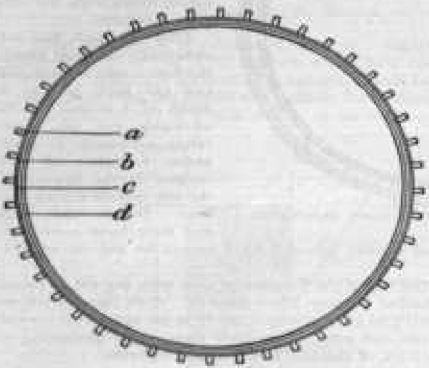

FIG. 6.—Cross section of silo, showing arrangement of studding and three inner layers.

When the sheeting and lath have been put on to within about a yard of the top of the first length of studding, a temporary platform or trestle may be laid to enable the workmen to erect the second half in the same manner as the first was put up. It is well to leave the center pole resting on the concrete floor and extend it by adding another piece.

The second half of the studding should be spiked to the first with a lap of about 2 feet. After plumbing and tying in place, the sheeting and lath are put on, and finally, after removing the temporary platform, the middle is completed by putting on the sheeting and lath. Care must be taken that no wide cracks are left.

The wall of the silo is plastered to a depth of about 1 inch—i. e., about one-half inch over the lath—with a rich, well-mixed mortar or concrete, made from 3 parts of sharp, clean, coarse sand or finely crushed stone and 1 part of good Portland cement. This mortar should be about as thick as that ordinarily used in plastering a house.

Figure 6 shows in diagram a cross section of the silo as it has been described thus far. Three inside layers are seen. The innermost is the plastering, the next is the lath, and the one lying against the inside edges of the studding is the sheeting.

Figure 7 shows a small part of the same cross section more in detail.

Figure 8 shows a longitudinal section taken down the side of one of the studs, showing the cement plaster, the lath, and the lining.

Four doors are sufficient for a 30-foot silo, and five are enough for a 36-foot silo. Ordinarily the bottom of the first door will come about 2½ feet above the sill. The doors are 2½ feet high, and 4 feet are allowed between doors.

When the studding is being spliced for the erection of the upper half of the silo, care must be taken that the studding between which the doors are to come

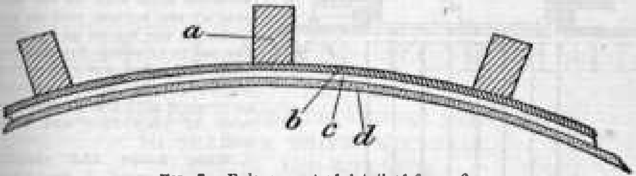

FIG. 7.—Enlargement of detail of figure 6.

are not lapped, but are put end to end and tied together with a 6-foot piece of 2 by 4 spiked to each at the junction. This allows a door jamb which is simply another 2 by 4 set back from the inside edge of the stud an inch and a half and either well spiked or bolted in place. Figure 9 shows this region, including the door in place, in cross section. The upper and lower jambs of the door are made from short lengths of 2 by 4 spiked across at the proper places.

The doors themselves are made from flooring boards nailed and screwed together at right angles, with a sheet or two of tar paper between. This construction is illustrated in figure 9.

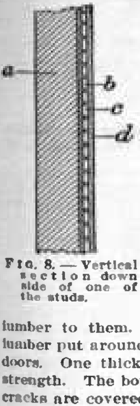

FIG. 8. — Vertical section down side of one of the studs.

In fitting the doors before filling the silo, a layer of tar paper or heavy building paper should be put between the jambs and the doors. The doors are held in place by heavy bolts, fitted with large nuts and washers, passing through them and through pieces of 2 by 6's laid across the opening on the outside of the silo. Two crosspieces are needed; one near the bottom, the other near the top of the door.

When this point in the construction of the silo is reached, although not completed, it may be filled if it is necessary to do so. Figure 1 on page 19 shows such a silo which has been filled and emptied once. Its general appearance, strength, and resistance to weathering, may be improved, however, by putting on a roof and some weatherboarding or siding.

Although somewhat expensive, galvanized sheet metal makes a good siding. Probably the most practical plan, however, is to put on some hoops and nail ordinary boxing lumber to them. The hoops are made of three thicknesses of the sheeting lumber put around the outside of the silo every 4 feet, being careful not to cross doors. One thickness is put on at a time. The joints must break to insure strength. The boxing lumber is put on vertically and nailed to the hoops. The cracks are covered with ordinary weather strip.

A plate similar to the lower sill is put around the top of the silo on top of the studding. The roof is usually made in the same manner as the roof of a

house, except the rafters are put up in conical form, and no joists are put in. The roof boards are put on in short lengths, and shingles or some other good roofing material put on top. A properly made door must be left in the roof through which to fill the silo.

When the silo is covered on the outside in any way other than with hoops and vertical boxing, it is necessary to bore a large auger hole between each stud on the outside at the bottom and on the inside at the top so as to allow the air to circulate through the wall and keep down decay of the woodwork. All holes should be covered with fine-mesh woven wire to keep rats and mice out.

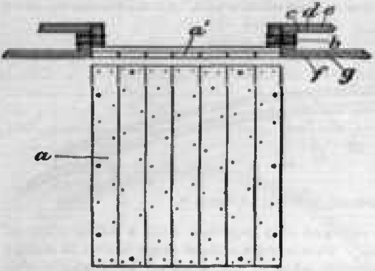

FIG. 9.—Detail of door and jamb.

When hoops and vertical boxing are used, a few large sawed holes about 4 by 6 inches in size at the bottom and top will serve, since the air can readily pass between the boxing and the studding.

It is necessary to anchor the silo firmly with three or four strong guy wires or cables of short length. These are very valuable in case of windstorms. They are attached to sleepers buried several feet in the ground about 4 or 5 feet out from the base of the silo, and run to a point on the studding about halfway to the top of the silo, where they are firmly secured.

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